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RUBBER
AND
Gutta Percha Injections

SUBCUTANEOUS INJECTIONS OF RUBBER AND GUTTA PERCHA FOR RAISING THE DEPRESSED NASAL BRIDGE AND ALTERING EXTERNAL CONTOURS

BY

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203290
22. 5. 26

CHICAGO
1923

OAK PRINTING & PUBLISHING CO.
CHICAGO

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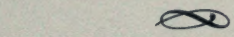
Rec'd May '76

EXPLANATION



It may appear strange to some readers that products so simple as crude rubber and gutta percha should not only be described in the text but illustrated as well. When the circumstances are considered the reason for this will perhaps be plain enough. Rubber and gutta percha being commercial products are produced in enormous quantities and in widely different parts of the world. Analysis of rubber is not possible. Commercial users satisfy themselves as to the character of the samples which they intend to use by a few simple tests. It therefore seemed best that the writer give his prospective readers an opportunity to as nearly as possible see the actual products with which he worked.

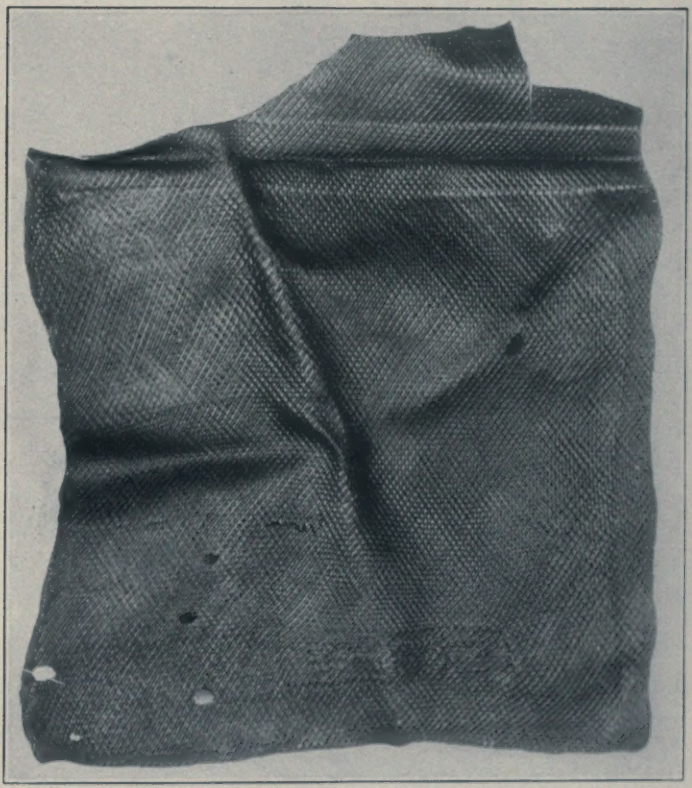


Figure 1. Sheet of crude smoked plantation rubber. The sheet weighs about one pound. The holes were made by samplers for testing in its course from plantation to user. This sheet is dark brown in color and has a strong creasote odor.

Figure 2. Shavings of gutta percha purchased from a drug jobber in Chicago. The samples are rather leathery in feel, slightly porous and quite brittle, the edges breaking up readily when rolled in the fingers. These chips have a distinctly tolu like odor.

Figure 3. In the right hand may be seen two small sheets of dental gutta percha. These are variously colored, have little odor and while the material can be broken it is very firm and bends rather than breaks.

In the left hand may be seen a sample of rubber prepared for curing. This product proved quite irritating when injected into guinea pigs and as the reaction was distinctly more than that from other materials previously used the writer merely tested it on guinea pigs.

Figure 4. Sample of sponge rubber. This product comes in the form of large sheets. In the right hand may be seen particles ready for grinding.

Figure 5. The ordinary rubber sponge such as is used in the household. In the right hand may be seen pieces cut for grinding. In the left hand is the sponge uncut.

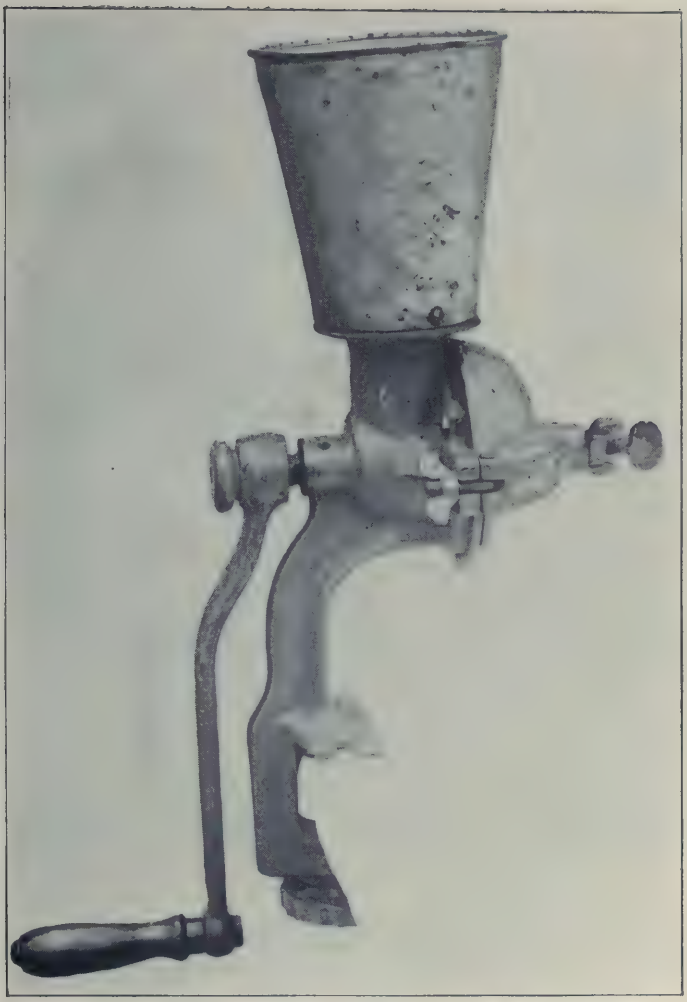


Figure 6. Mill used in grinding cured rubber.

Figure 7. For convenience in grinding the top of the mill is removed. This mill while inexpensive was quite powerful.

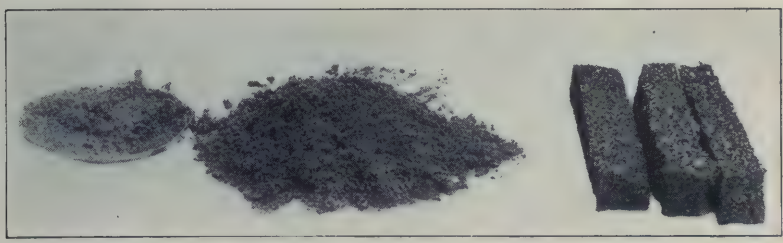


Figure 8. Sponge rubber, the ground rubber and paste made from the ground rubber and glycerin in order from right to left.

Figure 9. Barrel of syringe. Manner of loading. The reader can get some idea of the size and heavy construction of the syringes used by the writer. In certain cases where the mixtures are very stiff all the strength of the syringe is needed to resist the strain put upon it.

Figure 10. The syringe loaded and ready for use.

While several pages have been devoted to illustrating the types of cured rubber and their manner of preparation, it is the opinion of the writer at the present time that the vulcanized rubbers will not prove quite as satisfactory as the crude rubber or gutta percha. The additions in the form of various chemicals in the preparation of cured rubber will always make their constituents much more uncertain than the unvulcanized gums. The writer has given them space in order that others interested in this technic may have the benefit of his experiments.

RUBBER AND GUTTA PERCHA SUBCUTANEOUSLY

It has long been known by the surgical profession that insoluble foreign bodies aseptically deposited in the tissues cause little or no trouble and are likely to remain indefinitely without marked changes about them after the first reactionary phenomena subside.

This knowledge came first to surgeons through the tolerance of the body for projectiles which happened to enter the body uninfected. Even in ancient times it was known that arrow or spear heads sometimes caused little or no trouble, and with the introduction of firearms surgeons soon learned that bullets might remain indefinitely in the tissues without causing appreciable injury to the carrier.

16 Insoluble Foreign Materials Inert in Tissues

Realizing that foreign materials when insoluble are inert in the tissues aside from insignificant changes in cells in immediate proximity, foreign substances have been buried in various parts of the body to meet surgical needs and results have been secured in a variety of surgical procedures as a consequence of this knowledge of the bodily tolerance.

THE PARAFFIN TECHNIC

When paraffin was first recommended, early in the twentieth century, for subcutaneous use, it was presumed to be insoluble and inert when it had a melting point higher than that of the body temperature. This drug obtained a wide vogue among surgeons all over the world. The ease with which the drug could be sterilized and then in a softened state injected through hypodermic needles excited a tremendous surgical interest, and the method became so much a part of the technic of many operators that in spite of manifest unfitness for subcutaneous use paraffin is still being injected by surgeons who for years have realized how inevitable undesirable results accrue in a certain percentage of cases.

18 Unfortunate Results of Paraffin Injections

Those in surgical practice fifteen or twenty years ago found this technic one which enabled the surgeon to very quickly fill various body depressions and the demand at this time for this kind of surgery was very great. This agent was not in use long before thoughtful operators suspected that it was not to prove to be an unmixed blessing to patients and time showed this to be true, for even in the hands of experienced operators who could effectually avoid the disasters likely to result from its careless or unskilled use, unfortunate sequelae, which could not be anticipated, would develop.

Perhaps the commonest rather early undesirable result was the development of a chronic dilatation of the small blood vessels overlying the injection. This was apparently unavoidable and would completely spoil results which otherwise would have been successful injections.

Somtimes a persistent general redness of the skin overlying the injection would be responsible for subsequent unhappiness to the surgeon and the patient.

Other cases developed unnatural discolorations and the writer has seen conditions which at first glance the dermatologist would have termed rosacia.

Some cases tolerated paraffin without external visible signs, but after many months tumor growth gradually developed, and in cases where any considerable degree of tension was produced more or less breaking down of the tissues sometimes followed long after one would expect such unfortunate complications.

When unhappy results found their way into medical literature surgeons at first loath to abandon such a convenient and apparently useful method tried in one way or another to attribute complications to

faults of the individual operator. All manner of suggestions were put forward in explanation. Bad results were attributed to infection, improper selection of paraffin, mixtures too hot or whatever explanation most appealed to the writer who attempted to defend the method.

PLASTIC SURGERY VERSUS PARAFFIN INJECTIONS

Many surgeons who had had early experience with the drug realized that the fault was inherent in the drug itself. The writer suspecting that the universal application of paraffin to all manner of featural operations was not to prove permanently satisfactory began to develop various operative steps in the nature of plastic surgery as a means of getting away from this use of paraffin in the tissues of the face. During the years between 1903 and 1907 he contributed a great many articles to the medical press advocating a variety of plastic operations as more useful for altering the features than paraffin injections.

22 Demand for Surgical Skill Obstacle to Many Would-Be Featural Surgeons

Of course open plastic operations, surgical measures of the most delicate kind, did not appeal to many who were freely injecting paraffin. It is unfortunate that featural surgery which requires the highest degree of surgical skill should appeal so strongly to men of the most mediocre ability and that these men without even the temerity to attempt operations which are really indicated for the alteration of the features will try to substitute a procedure like paraffin injection because they feel that such injection is within their ability. Being unsuited for its purpose the paraffin injection no matter how made or how lacking in bad effects can never accomplish that which the operator hoped that it would. Condemnation of paraffin was, one might say, almost a death blow to many such operators, so while my contributions on plastic surgery were favorably received a great many surgeons gave

little heed to them as being out of the range of their capabilities and set themselves desperately to the task of finding a substitute for paraffin.

A lack of originality was obviously conspicuous in this search. Perhaps it was due largely to the caliber of the surgeons interested, for many who were able, like the writer, avoided paraffin in featural surgery and were content to use plastic operations to secure the effects desired even though in so doing we had to perform operations which made a greater demand for technical ability than did paraffin injections.

Those who were determined to continue the use of paraffin tried and advocated various mixtures, all manner of grease mixtures were experimented with, animal, vegetable and various mineral fats put together in every conceivable way, but it was grease, grease always.

24 Injection of Patient's Own Fat As Substitute for Paraffin Injections

Time passed and these surgeons began to insist that it was the mixtures. With short memories and no doubt in many cases limited experience, these operators reverted to plain hard paraffin. While it is true perhaps that hard paraffin is among the least harmful of grease compounds (the patient's own fat being the only exception) it had long been obvious to the open mind that the fault of such injections was an inseparable one common to all foreign fats hard enough to resist absorption.

MASS TRANSPLANTS VERSUS SUBCUTANEOUS INJECTIONS

With the fall of paraffin in favor some surgeons have come to advocate transplanting of bits of tissue favoring as a rule bits of fat taken from unexposed parts of the body and transplanted to cavities or depressions which they wished to fill.

The first objection to fat transplanting by open operation is a grave one in featural surgery, namely, the difficulty of preventing visible scars. To avoid this the writer during the past few years has resorted to a technic of excising a segment of fat from the patient's abdominal wall, inserting this in a powerful screw piston syringe and injecting it subcutaneously into the depression which it was intended to fill.

By this technic of injecting the patient's own fat not only is scar formation prevented in the overlying skin but it is possible to secure a natural appearing correction of the featural condition, something seldom possible by mass transplants of fat. In these injections of the patient's own fat a rather large strip should be cut and dropped into the sterile syringe barrel. A very large needle should be used. This allows the fatty tissues to be easily forced through and insures against fat embolism as the needle is too large to lodge within the walls of a vein. If the surgeon fears fat embolism the needle may be inserted before the syringe is attached, then if its point be within the lumen of a blood vessel, blood will flow and the surgeon will be warned. He may then change the point so that it is no longer within the blood vessel before attaching the syringe and making the injection. Many times the writer

has thus inserted large needles unattached into the subcutaneous tissues of the face and he has yet to see one which has had its point lodged within a blood vessel. Fat deposited through a needle when taken from the patient is tolerated just as well as though it were transplanted in one single piece, in fact the writer is inclined to believe it is better tolerated, it is certain that it is very much easier by this technic to secure a perfectly natural appearing correction of a featural imperfection. Those surgeons who have had very much experience with paraffin injections can usually easily and quickly make a very accurate correction of the defect which is suited for such operation.

While surgeons frequently present cases in medical literature where mass transplants have been made through open wounds, and the results appear well on photographs, which are always labelled

"not retouched" these photographs to say the least are deceptive. To the uninitiated the photograph which has not been retouched is supposed to give a clear idea of the actual state of the parts, but with present day camera skill retouching is a very crude and out of date way of securing flattering photographs. There is always an angle of view which will hide a pronounced defect, and leave it to a good camera artist, he will find that particular angle. Then, too, modern camera lenses do wonders in giving apparently clear likenesses without showing blemishes. It is the same with scars, the expert camera operator can give you a perfectly clear view and prevent even a conspicuous scar from showing. One of the ways of doing this the writer has been told is to photograph through a thin film of gauze, the gauze not showing, neither will lines or scars. The writer would not devote space to this were it not

that there is a widely prevalent impression among members of the profession that chunk transplants are effective. In featural surgery such transplants and skin grafting leave much to be desired in spite of widely prevalent impressions to the contrary. Chicago for many years has been blessed with the most expert of plastic surgeons and the writer has seen many cases operated upon by surgeons rightly enjoying high repute, yet he can honestly say that he has yet to see a fat transplant made in one piece or a skin graft of any considerable extent upon the face which fully corrected an abnormal featural condition or even left a cosmetic result which might be considered genuinely satisfactory. Too frequently indeed such operations have left genuinely unnatural appearance of the parts operated upon. The difficulty of securing perfectly natural appearing corrections by injections is not great. Realizing

this with a view of adding to the surgical armamentarium an insoluble unirritating material which might be used by injection the writer began experimenting with the use of rubber in various forms.

RUBBER AND GUTTA PERCHA SUBCUTANEOUSLY

Rubber itself is non-toxic to the human body. Cured rubber, the ordinary rubber of commerce is essentially rubber and sulphur which have been heated together. Much experimentation with many different chemicals has been tried by manufacturers, the simplest of the cured rubbers is rubber and sulphur. This when cured is quite black. When white rubber is desired zinc oxide is usually added, commonly red rubber is secured by the addition of sulphide of antimony.

32 Gutta Percha Secured Only From East Indies

As several forms of rubber seem to resist body fluids indefinitely the writer is inclined to believe that they will prove useful in the filling of body spaces or depressions provided such injections are made discreetly in properly selected situations.

There can be no doubt that gutta percha proper will resist absorption indefinitely. The writer is now speaking of the product introduced from Singapore into England in 1843. This is secured from a tree of the natural order, Sapotaceae. These trees are found only in the islands of Borneo, Sumatra and a portion of the Malay peninsula. Its latex differs in some very important particulars from India rubber. Gutta percha when heated to 150 degrees F. becomes soft and pliable. Gutta percha is rather extensively used in dentistry owing to this pliability when warmed. For many years it has been a favorite filling for

root canals and remains indefinitely unchanged in such situations. Of course the root canal is little exposed to body fluids when the nerve has been destroyed in filling the canal, but no surgeon of much experience has not seen gutta percha which dentists have inadvertently pressed through the root canals into the vascular tissues adjacent to the root apex. These migratory bits of gutta will remain indefinitely in the tissues causing no harm when the region is uninfected. Of course the dentist will tell you that such bits must be removed but this is due to the fact that so often the patulous root canal at the apex rests in chronically infected tissues, and then the gutta percha is like a splinter in an infected wound and favors the continuation of the suppurative process as will any insoluble foreign body. It has been the writer's experience to see these bits of gutta percha in vascular tissues

about the apex where they have been inserted years before, but from their size, shape and location in radiographs one can be quite sure that they have undergone no appreciable changes since their inadvertent deposit.

COMMERCIAL RUBBERS IN SURGERY

Some of the writer's first experiments were made with gutta percha. The writer made a number of injections into guinea pigs and found it invariably well borne when deposited with proper antiseptic precautions. It is the writer's belief that no preparations of rubber or gutta percha should be injected into patients until a number of injections from the individual supply which it is intended to use has been tested upon laboratory animals, no matter from what source the gutta or rubber is obtained. Briefly, the reason for this is that all forms of rubber are com-

mercial products and that while these samples may be subjected to a variety of tests it must be remembered that the constituents of rubber are only known in a general way. Chemists tell us that the major portion of rubber is polyterpene presumably of large molecular structure but all samples contain an appreciable amount of unknown resins and protiens. In addition to variations in the crude rubber our sources of supply are from manufacturers who are constantly adding to rubber chemicals in great variety. It is not the fear of the toxic nature of these products which should cause us to thoroughly test all samples biologically for the dissolution of all rubber injections is so slow that toxic products could hardly prove harmful in this way but there is always a possibility that the rubber may contain some chemical or compound which might cause chronic congestion about the injection.

The writer has been inspired to take these precautions by the experience which the profession had with the bismuth paste injections some years ago. Bismuth was recommended mixed with paraffin as an injection for the cure of rectal fistula. Now anyone who knows anything about rectal fistulae would never try to cure them by such means, but the suggestion inspired the writer to make some tests of bismuth salts subcutaneously. He found that the bismuth salt recommended, injected in either an oily mixture or in a watery mixture caused a chronic fluid effusion into the tissues all about the injected drug, that it did not absorb but remained for many months an elastic cystic tumor which when punctured allowed the oozing of serum, broken down blood corpuscles, pigment and the drug unchanged. A few light colored samples of rubber contain bismuth, not many, because the salts

of this element are rather expensive, but whenever the surgeon would inject the very light colored rubber mixtures, in view of the above mentioned circumstances, the writer would suggest that the sample be tested for bismuth and rejected should the test show its presence.

It is so little trouble to inject guinea pigs with portions of the rubber mixtures which the surgeon proposes to use upon his patients and to wait a few weeks to see that they produce no deleterious effects that the writer feels that this precaution should always be taken before using any of these injections on patients. Guinea pigs are now so easily available to the medical profession, practically all hospitals being well supplied, that the physician can thoroughly test out his product before using it with but very little inconvenience to himself, and by such tests should he save

himself from a single unhappy result he will be very well repaid for his trouble. It has been the experience of the writer in his experiments with a variety of rubber compounds, that those which were tolerated by the guinea pigs have invariably been tolerated by patients when subsequently used upon them.

GUTTA PERCHA—SOURCE AND CHARACTERISTICS

Pearson in his excellent book, "Crude Rubber and Compounding Ingredients," says:

"Gutta Percha was introduced into Europe from Singapore in 1843, was for a while confounded with India rubber, from which it differs in some very important particulars. It becomes soft and plastic on immersion in hot water, retaining the shape then given it on cooling, whereupon it becomes hard but not brittle like other gums. India rubber, on the other hand, does not soften in hot water, and retains its original elasticity and

strength unimpaired. The water as such, exercises no softening action on gutta percha, the effect being purely one of temperature, which may equally well be produced by hot air, only somewhat more slowly. The degree of heat required depends upon the quality of the material, but even the hardest kinds become plastic above 150° F. Heated in air considerably above the boiling point of water, gutta percha decomposes and finally ignites, burning with a luminous, smoky flame and emitting a pungent odor resembling that from burning rubber. If heated in a vacuum gaseous and liquid products are obtained similar to those resulting from the distillation of rubber. The liquid which distils over consists chiefly of hydrocarbons of the terpene series, which form an excellent solvent for caoutchouc. The two most important are isoprene and caoutchine, which are

identical with the liquids by the same names obtained from India rubber. * * *

"A curious physical characteristic of gutta percha is that when it has been softened in water, although it is so plastic that it will reproduce the most delicate impressions, it will withstand blows from hammers or may be thrown against stone without being marred. The reason is that it contains a large amount of air. By subjecting gutta percha to a vacuum, a large amount of air is withdrawn from the gum, and it loses its property of hardening in cooling, its substance being like a tough, greasy leather.

"Genuine gutta percha trees are found only in an area embracing portions of the Malay peninsula, Bornea, Sumatra and adjacent islands. These trees belong to the natural order Sapotaceae.

"Pure gutta is insoluble in ether and light petroleum spirit at ordinary temperatures, whereas both albane and fluavile dissolve readily in them. Gutta possesses all the valuable qualities of gutta percha but in a much enhanced degree; it becomes soft and plastic on heating, and hard and tenacious on cooling, without being in the least brittle. But the resins themselves at ordinary temperatures are either soft or quite friable. It is, therefore, gutta which forms the useful constituent of gutta percha, and the resins are only accessory components, which although admissible and perhaps, even desirable in a comparatively small amount, yet have a decidedly detrimental effect when they preponderate. Hence, in order to determine the technical value of a sample of gutta percha, it is necessary first to learn the relative proportion or ratio between gutta and resins. There must also be taken into account the

water enclosed in the mass, and the coarse impurities—wood fibers, bark, sand, etc., which are described as dirt, * * * while the relative proportion of gutta and resins forms an important criterion for estimating the commercial value of a sample, it is not in itself sufficient. Although the analysis of two different samples may give the same result, the physical and mechanical properties, and, most important of all, the durability, may differ widely, owing to a difference in their molecular constitution. It will thus be seen that there are guttas and guttas. In addition to the qualitative analysis, it is necessary to scrutinize the gutta itself, which requires much judgment and experience. Analyses have been made of specimens which contained eight times as much gutta as resin, others contained about an equal amount of both, and in still others the

amount of resin was three times that of gutta. Samples in which the percentage of resin reaches that of gutta or surpasses it are of decidedly inferior description. These differences are due doubtless to the fact that the gutta percha of commerce is derived from trees of various species, and also in part to the treatment that the gum receives at the hands of the gatherers, who are suspected of mixing the product of different trees, to say nothing of adulterations of a more debasing character.

"The commercial classification of gutta percha is less satisfactory than that of India rubber, since no standards have become fixed in the markets. While Para rubber may be bought and sold by means of established designations, "Islands fine," "Upriver fine," and the like, no such practice exists as regard to gutta percha. Since all transactions are based on samples, trade

names and brands are little considered. * *

"A grade of gutta percha which is nearly white in color and very brittle is apt to contain a large percentage of resin, which, as already explained, renders it of little value.

"Gutta percha is obtained principally by cutting down the trees and ringing the bark at intervals of twelve to eighteen inches along the trunk. The milky sap in a little while fills the grooves cut in the bark, and, in the better varieties soon coagulates, when it is scraped off with a knife. In the case of inferior sorts, the milk requires more time to curdle, and has to be caught in receptacles placed under the tree. The collected milk is then gently boiled, either by itself or with the addition of water. The material obtained without the use of water is called goolie, the other a gutta, but the two kinds are often mixed together.

"The principal cause of the destruction of gutta percha is the absorption of atmospheric oxygen, which alters the gutta and produces a brittle resin of quite a different nature to that originally present in the material. This destructive oxidation is greatly assisted by light, and by other causes—for instance, by any action tending to make the material porous, such as alternate wetness and dryness, the presence of substances which exercise a solvent action on gutta percha as a whole or any of its components. Certain alkaline substances and decaying organic matters also appear to act injuriously, but frequently it is impossible to assign a definite cause to decay of gutta percha.

"Specimens of gutta percha are in existence which after proper means of protection have remained in good condition for over fifty years. Complete immersion in water affords a good protection for which reason submarine cores are more safely placed than underground wires."

TECHNIC OF INJECTING GUTTA AFTER HEATING

The writer among his earliest experiments used the dental gutta percha. This he secured in small sheets from the dental supply house. All these samples seemed to contain a good deal of filler, mineral salts added to give it bulk, to color it and to improve its qualities perhaps for the purposes it is intended.

This type of gutta percha the writer was able to force through large short needles after syringe and contents had been heated. The syringe used for this purpose

is made with a view of having a maximum strength and ejecting power. The capacity of the barrel is large, over two and one-half fluid ounces. The barrel is made from heavy brass tubing intended to stand a minimum pressure of one hundred pounds to the square inch without danger of giving in any way. The needle end of the barrel is closed by threading in a solid metal piece which for added security is soldered. The needle end of the barrel within tapers in a cone or funnel shape into the needle adapter and this tapers in a similar manner into the lumen of the needle, when this latter is screwed in place. The needle adapter is long and sets deeply into the butt of the needle and when the latter is securely threaded in place no washer is needed to prevent escape of the injection at the point of attachment of the needle.

The piston is made solidly on to a heavy shaft which has a slow screw thread upon it, so that at each turn of the piston shaft the piston advances but little. A large handle on the piston shaft allows the surgeon to use his strength when necessary in turning the piston and a large hand hold on the barrel permits a firm grip on the syringe.

In order that needles will offer a minimum of resistance the writer has equipped himself with a fine drill and he makes sure that there is no constriction particularly at the point of juncture of the butt and the needle shaft.

Samples of gutta percha which the writer injected into guinea pigs were invariably well borne. There was of course some primary irritation immediately following the injections. This is not surprising in view of the fact that the gutta per-

cha does not become pliable under 150 F. For softening the gutta percha immersion of the syringe after it is filled in boiling water may be used, or a small oven may be made into which the syringe is placed. For guiding the surgeon as to the temperature of the oven a small oven thermometer should be allowed to project from the oven. With the oven the syringe may safely be heated to 250 F. Too much heat will decompose the gutta percha.

The most convenient way to handle the syringe when hot is with heavy rubber gloves. Should the operator prefer he may slip rubber tubing over those parts of the syringe which come in contact with the hands. These serve to insulate the syringe and cause it to cool more slowly, but the operator who expects to use gutta percha softened by heat alone will have to work with expedition for the needle will

cool rather rapidly and any hesitation may allow the gutta percha to cool in the needle and consolidate to such degree that no amount of pressure will start the flow. When this happens the syringe must be withdrawn and the needle heated. The needle can be reheated in a bunsen burner, but care must be taken not to cause the gutta percha to fuse from too much heat as the needle then sometimes blocks worse than ever and it is necessary to change needles. With practice the surgeon becomes acquainted with the peculiarities of this material and soon learns to handle it so that he can inject at the rate which he desires. It is well from the very start for the surgeon to observe closely the manner of action of these injections. The marked tendency of gutta percha when injected is to lump. As the operator must give close attention to the flow of the injection

he may not note this tendency and take adequate precautions to prevent undesirable lumping unless he is warned as to this pronounced tendency.

GUTTA PERCHA IN THE TISSUES

Gutta percha when cooled in the tissues cannot readily be changed in shape. It should be the purpose of the operator to inject it in such manner that it will need the least amount of changing after injection, and to affect any change in the shape of the injection immediately after it is made. Unless he do this he may find after the injection has been made and the reaction has subsided that the result is not what he wished and he will find himself impelled to remove part or all the injection. Fortunately these rubber injections

are peculiarly easy to remove if the operator so elects, they are not difficult to find in the tissues and can usually readily be turned out of small punctures. The writer is now speaking of the removal of the injection from guinea pigs for he has not as yet had any of the patients which he has injected need such removal. Nevertheless there is no reason to believe that it will prove any more troublesome to remove the rubber mixtures from patients than it has been from the guinea pigs.

Before leaving the subject of the tendencies of the injections in the tissues the writer would call attention to the particular operation of raising the nasal bridge. This is an operation when properly performed which is brilliantly successful. The surgeon should not forget that the good looking nasal bridge, is not only straight, but also that it is narrow. A broad, thick nasal bridge is far from handsome and the

operator who loses sight of this is likely to be disappointed in his result. Particular precautions, therefore, should be taken in injecting for raising the nasal bridge to see that the injection does not spread laterally more than it should.

Following the subsidence of the primary reaction the writer has had no undesirable features manifest themselves in either guinea pigs in which test injections were made or in patients which were injected for the purpose of altering external contours, the gutta percha may be felt under the skin, in some situations being well defined and in others where it is rather close under the skin and where the tissues are rather bulky with subcutaneous tissue and fats, it is less well defined. In injecting the gutta percha he has used the seventeen gauge needles and while these necessarily were rather hot the needle punctures have closed without leaving visible marks.

In making all manner of rubber injections care should be taken to see that none of the injection lodge in the layers of the skin itself. This may be prevented by giving a quick reverse turn on the piston immediately before withdrawing the point through the skin. The surgeon too should never neglect to examine the skin puncture and to strip out any particle which may be noted in the skin itself, and it is not amiss to have at hand a very small hook which may be inserted into the skin puncture and with which any bit of injection in the skin itself may be stripped out. This precaution is necessary as a particle of injection lodging in the skin itself will sooner or later become infected.

In a dozen and a half injections of patients the writer has had the puncture wound become infected in one case, a wilful and disobedient young woman who

picked off the dressing on the evening that the injection was made. The skin puncture had been sealed with collodion and covered with plaster. Both of these the patient removed in order that she might bathe the parts with boric acid solution, because she said the parts felt hot and burning. The skin itself became infected, a small abscess formed but fortunately the infection did not spread to the injection. In this case fortunately there was an appreciable space between the skin puncture and the injection. After the infected skin wound had been swabbed with tincture of iodine the suppuration ceased and the wound closed leaving a very small point-like scar. All infections may not so limit themselves and extreme precautions should be taken to insure asepsis in all stages of these operations, for actual suppuration about an injection in all probability would demand an opening of the

skin and a removal of the injection, for it is likely that once infected the rubber would act here as does any foreign body in an infected wound and tend to keep up the infection.

GUTTA PERCHA OR CRUDE RUBBER

The writer has gone into the subject of injecting the gutta percha unchanged by any chemical owing to the fact that he feels that when so injected there is very little likelihood of it being subsequently absorbed. The addition of solvents may act not only to soften it but at the same time allow more or less absorbtion of the injection to occur. If such absorption is immediate with carefully measured amounts of injection the surgeon may slightly overcorrect and thus allow for absorbtion, but

the writer's experience so far with the solutions of gutta percha and of rubber do not allow him to say definitely. It will probably be only after the lapse of a good deal of time and the study of many cases before one may speak dogmatically regarding the action of the rubber solutions or the gutta percha solutions. Time too may show that rubber is quite as well borne and as permanent in its effects as is the gutta percha. If such is the case the rubber will be the preferable injection as the rubber sheets can be secured in a form which seems to be much more uniform than the gutta percha. Sheets of crude rubber from the large estates where rubber is cultivated and the crude rubber carefully prepared are quite free from contamination. This cannot be said of the gutta percha which the writer has been able to secure in crude form. The gutta percha which the writer has

secured from local drug jobbers appears in the form of chips or shavings of a grayish brown color. They are about the consistency of soft rather pliable leather. These chips are slightly porous, float on water and soften quickly when directly exposed to heat. Many dark red specks may be seen irregularly scattered through the gutta, these being usually bits of wood and bark. As some of these particles are large enough to block even the larger gauge needles the writer has before injection either strained the solution through closely woven cotton goods or practiced a simple system of precipitation and re-solution of the drug.

The quantity of gutta and of resin in samples of crude gutta percha vary widely some samples of gutta having eight times as much gutta as of resins and other samples running twice as much resin as gutta.

These later samples are considered the poorest. The writer presumes that the method of preparation which will eliminate the resins and retain the gutta will perhaps give the samples which will be most useful in filling tissue spaces. This presumption may of course not be found to be correct. The resins themselves have a tolu like odor. They may add to the insolubility of the gutta in the tissues and may have no deleterious effects, certainly the crude samples which were carefully strained have caused no alarming symptoms of any kind.

METHODS OF PREPARATION OF GUTTA PERCHA FOR INJECTION SUBCUTANEOUSLY

Eugene Serullas uses a system of purification by dissolving the crude gutta percha in hot toluene and then precipitating the gutta with acetone. In view of the highly inflammable character of the toluene, the writer has not attempted to heat it but by allowing the gutta percha chips to soak in it for twenty-four hours or more has found that they dissolved. After this it is a simple matter to strain the mixture through several layers of tightly woven cotton goods as the compound is poured

into a tight bag made of such material and the contents squeezed through the walls. After this by the addition of the acetone the gutta percha is precipitated. It is then allowed to dry thoroughly. The process may be hastened by gentle heat. After the acetone has been thus driven off the gutta may be redissolved in any of the usual solvents.

A number of different drugs may be used to dissolve gutta percha. No doubt a great deal of experimenting will have to be done, and a long time elapse before we may be sure of which drug that it is best to use. The writer has assumed that those which belong to the benzine group had best be avoided. We know that our experience with paraffin was not satisfactory. It is possible that a gutta percha injection if impregnated with gasoline or benzine might very gradually give it up to the

tissues and produce a chronic irritation as did the paraffin injections in far too many cases. Of course it is possible that such will not prove to be the case, nevertheless the writer has been inclined to use agents belonging to somewhat different groups from a chemical standpoint.

The choice of solvent for crude rubber was very easily made by the writer. Ether is very well borne when injected into tissues or when used intra peritoneally. All surgeons know this and have seen how freely a can of ether may be poured into the abdominal cavity during operation for sterilizing an infected peritoneum. No precautions need be taken to remove it. Ether therefore furnishes a convenient solvent for crude rubber and one which we know from other surgical experience that we need have no fear, but unfortunately ether does not dissolve the gutta percha.

Chloroform and Tetrachloride of Carbon Should Prove to Be Safe Solvents for Gutta Percha

Chloroform and carbon tetra chloride both dissolve the gutta percha chips or the gutta which has been precipitated with acetone. It is realized by all surgeons that chloroform is much more toxic than ether, and while some say that carbon tetra chloride is more toxic than chloroform and other authorities say less there is no doubt that both drugs are more toxic than ether. The danger of course from chloroform is from rapid absorption. Small amounts of chloroform circulating in the blood do no harm, it is the excess dose in a very short period which produces dangerous symptoms. In view of the fact that thick gummy solutions of gutta in chloroform or carbon tetrachloride must give up these drugs very slowly it is safe to presume that these injections of gutta are very unlikely to be dangerous.

Hare asserts that gutta percha has no medicinal properties. He adds that it is never employed in internal medicine. This latter statement is perhaps as true now as it was when Hare wrote it quite a few years ago, but the writer is inclined to believe that gutta percha might be found to possess valuable medicinal qualities were measures taken to secure its ready solubility.

The list of solvents for rubber and gutta percha is a very long one. It is quite possible that solutions might be found which would allow ready absorption of these colloids and valuable therapeutic properties might be developed. Hare calls attention to the use of solutions of gutta as a substitute for collodion and states that such gutta solutions are reputed to be of advantage in the treatment of lepra, psoriasis, eczema and other forms of skin diseases. In this connection the writer had one in-

teresting experience which perhaps deserves a few words.

One young woman who desired certain deficiencies in the tissues of the face and neck filled out somewhat was given three injections at intervals of ten days, the first ground sponge rubber mixed to a paste with glycerin, the second gutta percha softened by heat and the third uncured smoked rubber dissolved in ether. The injections approximated between two and three c.c. each. For six years preceding the injection she had had a rather extensive psoriasis on arms, legs and back. Shortly after the last injection she noted a marked fading of the injections, the scaling having quite ceased. This patient had had much treatment several years before and had given up efforts to be rid of the eruption. The eruption has faded away very much like certain of these rashes fade when

actively treated with chrysarobin ointment. This young woman had had no local or constitutional treatment for her skin trouble for two years preceding the injections and the writer while advised of its presence at the time of the first injection had not volunteered to attempt to treat it and she had no treatment from him except the injections. The effect was as unexpected to him as it was to the patient, provided it is an effect and not a coincidence.

As has been mentioned before the list of solvents for gutta percha is a long one and the writer shall attempt to describe only a few of the experimental injections he has made with those combinations which he believed would prove satisfactory.

RUBBER AND GUTTA PERCHA SOLUTIONS

Those liquids belonging to the benzine group may no doubt be avoided advantageously. We know from our experience with paraffin injections that very unhappy after effects may persist following injections of paraffin mixtures. It is the writer's belief that much of this trouble was due to the members of the group with a low melting point. Now if such should happen to be the case and the rubber mixture in naptha, benzine or petroleum spirits gave up the solvents slowly then effects from such injection might be similar to that from a paraffin injection.

72 Gutta Percha Is Not Soluble in Ether

Gutta percha is not soluble in ether. This drug has proven satisfactory for making up the crude smoked rubber mixtures. The writer has used carbon tetra chloride and chloroform. Neither of these drugs are much used internally so that opinions vary among therapists as to the actual toxicity of the two drugs. Some assert that chloroform is more toxic, others the reverse. It is true that chloroform appears to be the more volatile, and the writer is inclined to believe that actual tests would show the absorption more rapid from mixtures containing it than from the tetra chloride mixtures. From either absorption is apparently so slow that the surgeon need have little fear when one considers the comparatively small quantities which will almost invariably be indicated.

Some chemists declare that those agents which are so often considered as solvents

for gutta do not produce an actual solution, but that the gutta is merely jellified. This of course is not objectionable to those of us who wish the mixtures to remain permanently at the sites injected so long as the combination is easily injected and well tolerated. A considerable amount of gutta can be dissolved or at least softened by a very small amount of chloroform or carbon tetra chloride and if the surgeon equip himself with a powerful screw piston syringe the injection may be made with an ease and accuracy which is very satisfactory. The writer has presumed that this was likely to prove to be the most satisfactory technic, for while it is true that a large amount of the solvent and a small amount of gutta or rubber will make a solution so thin that it could be injected with an ordinary slide piston syringe it is hardly reasonable to assume that such

compounds would be as useful as fillers of tissue spaces as the thick compounds. It is possible that the time may come when surgeons wish to place very small amounts of gutta or rubber in a rather diffused manner that a technic will be developed for using the thin mixtures.

While there is always wide variation in each lot of gutta percha from different sources and the surgeon will be very much in doubt as to the amount of gutta and of resins each lot contains the securing of raw rubber is not beset with so great a problem as to the content of the raw product.

SOURCES AND MANNER OF GATHERING AND PREPARING RUBBER LATEX

The surgeon should secure his crude rubber from plantations where rubber is cultivated. Such products are made up on a large scale and the syndicates owning the plantations have come to realize the advantages of producing a clean and uniform rubber for the trade.

Crude rubber from plantations where the trees are grown and carefully tended contains comparatively small percentages of products other than the actual rubber itself. John B. Tuttle in his book, "The

Analysis of Rubber," asserts that plantation rubber averages about two percent of acetone soluble compounds called resins, and nitrogenous products akin to proteins from two to six percent.

The surgeon by securing his crude rubber in thin sheets may see whether or not the product shows any sign of gross contamination. One pound sheets of the best grade secured by the writer from local manufacturers have been peculiarly free from signs of contamination with extraneous matter for the writer has a number of times made smears of the jelled rubber and failed to find even with the microscope evidences of any noticable degree of contamination.

Wild rubber produced in the Brazilian forests by native gatherers is cured in large masses and usually is grossly contaminated with all kinds of extraneous matter. This

product should be avoided by the surgeon as the thin sheets above described are easily obtained from the better class of manufacturers of rubber goods.

Ether readily dissolves the crude smoked sheets so that mixtures of any degree of thickness may be obtained. Ether we know is well tolerated when absorbed into the blood and large amounts are safely left in the peritoneal cavity after operations on infected cases. It is therefore clear that the surgeon injecting the jellified crude rubber made up with ether need not concern himself as to the effects of the ether. As ether has active germicidal properties the writer has been satisfied to take fragments of the clean smoked sheets and soften them in the ether, sterilize the syringe by boiling, load it and inject after careful skin preparation of the patient. The crude rubber when made from

latex coagulated by smoking has a strong creasote odor and taste, a piece of the raw crude sheet rubber held in the mouth distinctly numbs the mucosa from the amount of creasote it contains.

The writer has been very careful in his antiseptic preparation of patients to be injected with rubber and gutta percha and would remind those who propose to use methods which involve leaving foreign materials imbedded in the tissues that too great care cannot be taken to insure perfect asepsis of patient, surgeon's instruments and materials to be so imbedded, that the foreign body buried in tissues once infected is likely to prove a harboring place and perpetuator of the infection. In injecting half a hundred times or more guinea pigs in experimenting with the various types of rubber, the writer has assured himself the sterility of needle

syringe and contents and has merely soaked the point of entrance on the guinea pig's skin of the needle with the ordinary tincture of iodine. He has had no cases of infection develop in these animals.

While the writer has been satisfied by the crude rubber jellified by ether he has one interesting exception which is deserving mention. A young woman of twenty-six had had for nine months a fistulous opening in the neck extending to a depressed point where a tubercular gland or glands had broken down. She was very anxious to avoid open operation and the writer after carefully stripping the cavity free of secretions injected through a small blunt cannula a mixture of crude rubber and creasote. The creasote was used to soften the rubber just enough to allow its injection. The cavity was injected, care being taken to flatten and spread the

80 Rubber Residue May Be Used As Aid in Defining an Infected Space in Tissues

injection just as much as possible so as to fill it without bulging it unnaturally at any point. The injection was stopped by reversing the piston when the cavity was sufficiently injected and the cannula withdrawn without injecting the passage to the tissue space. Discharge ceased from the fistulous tract and the wound closed. With the subsidence of the reaction which followed the injection an apparent cure has resulted. Whether it is permanent of course the writer does not know. Should it not prove to be and suppuration redevelop, the rubber residue will not be difficult to remove and it will help to define the infected space, though from present indications several months after the injection it appears that the cure is permanent.

FULLY CURED RUBBER AS AN INJECTION

When the writer first began his experiments with the rubber and gutta percha mixtures he was very sceptical as to the lasting qualities of the softened or jellified mixtures. His first injections with gutta percha softened by heat convinced him that many operators would have quite a little difficulty with the technic. It appealed to the writer that fully cured rubber would be more likely to be permanent than the softened compounds so he secured various samples of rubber and

ground them up in a small hand mill. This mill he secured in a "health food" store. It was primarily designed for grinding whole grain into flour from the entire kernel. The outfit while cheap is strongly constructed and capable of grinding various kinds of rubber into a coarse granular mass.

Various kinds of rubber were ground and tried in the writer's strongest syringes but it was found that without moisture they would pack and finally jam the syringe. Further experiments showed that ground sponge rubber moistened in glycerin would pass through aspirating needles quite readily.

Vulcanized rubber is an entirely different product from the crude rubber. As Tuttle states this difference clearly it may not be amiss at this point to quote him briefly. "The manufacturer, producer of

rubber products, in addition to the rubber obtained from the plantations, adds many other substances both organic and inorganic, because of certain qualities which such additions produce in the finished article. Moreover, chemically speaking, we have in the hot vulcanized articles an entirely new series of products, viz., the sulphur addition products of the polyterpene, a series which passes from the extreme of pure rubber at one end to a constant composition of $(C_{10}H_{16}S_2)x$ at the other end. While the hydrocarbon rubber is known to be in polymerized form, and has the composition $(C_{10}H_{16})x$ the size of the molecule is unknown, although it is believed by some to be quite large, but we do know that each group of $(C_{10}H_{16})$ contains two double bonds. Double bonds are unstable and there is always a tendency for such double bonds to add various

elements, or groups of elements, which will tend to produce a more stable form. Thus we find that the double bonds of rubber may take up oxygen, ozone, sulphur, selenium, sulphur chloride, chlorine, bromine, etc., producing new chemical substances with distinctly new properties, many of which are more useful in a commercial sense than the original substance. Industrially the most important of these compounds are those formed by the addition of sulphur monochloride, the chemical process being termed 'vulcanization,' or 'curing.' "

"Crude rubber is a soft plastic substance, soluble in naphtha, benzene, chloroform, carbon bisulphide, etc., from which by the simple process of evaporation it may be recovered in its original form. The addition of comparatively small amounts of sulphur is sufficient to destroy the solubility of these solvents."

It will thus be seen from a consideration of the foregoing excerpts that in cured rubber we have an entirely different product from the original crude gum. It impressed the writer that perhaps the vulcanized product might be more lasting than the raw product.

CHEMICALS FREQUENTLY ADDED TO CURED RUBBER BY MANUFACTURERS

Of course when we deal with a commercial product as complex as rubber and capable of being varied in so many different ways by manufacturers we greatly complicate the problem of estimating the effects of any particular product injected in the tissues. The list of organic and inorganic products used by rubber manufacturers is very great, the problem of determining just what has been used in a particular product with present knowledge of chemistry and analysis cannot be solved.

It therefore is even more essential to the operator who uses the vulcanized product to secure adequate quantities of the rubber he proposes to inject and to thoroughly test it out on small animals some time before he injects it in patients. Of course there is no particular danger of poisoning a patient by such injection because the extremely slow but the unpleasant result absorption from so resistant a material is possible is that the vulcanized rubber might contain some chemical which given off slowly would cause a chronic irritation about the injection resulting in congestion of the tissues over the injection or a cystic like state of the injection which would be undesirable.

Several types of vulcanized sponge rubber are to be found upon the market. The first of these is in the form of rather thick sheets. The rubber is rather compact, the air spaces being small. When cut into

strips it is readily ground into a granular state and in this form when mixed with glycerin may be forced through aspirating needles provided the syringe is strong enough to withstand rather high pressure. The second form of rubber sponge is the usual rubber sponge used in the household for various purposes. This sponge when ground will pass through the needle somewhat more readily than the first kind described. All commercial rubbers are colored, the natural color of the vulcanized product being a dirty blackish brown. Black rubber is usually colored with lampblack, white and various mineral salts such as zinc oxide, and red rubber with sulphide of antimony. Of course, too, aniline dyes may be used by the manufacturers, in fact usually are owing to the demand for clear bright colors in finished products.

Sponge rubber after grinding in the mill should be thoroughly washed in ether. The rubber ether mixture should then be poured in a muslin bag secured under the hot water spigot and hot water allowed to flow through the mixture. This will wash away the finest particles and any water soluble foreign material which the mixture contains. The mass should be thoroughly dried in an oven before it is made into a paste with chemically pure glycerin. Oils of course may be used in giving the rubber the viscosity necessary to enable it to pass through the needle but in view of the softening effects of oils on the rubber it is perhaps preferable that glycerin be used when this vulcanized rubber is to be injected. If the ground rubber is not dried the water in the mass may so lessen viscosity that the injection will pack in the syringe and the operator be unable to complete the injection.

The syringe is loaded by removing the piston and dropping the rather thin paste into the barrel. There is no danger of getting too much glycerin in the mixture as the glycerin will flow first from the needle and all excess of glycerin will be squeezed out before the rubber begins to pass.

When the barrel of the syringe is nearly full a small plug of sponge rubber should be inserted before the piston. This small sponge acts as a wiper, preventing particles of rubber working their way between piston and the barrel wall and jamming the instrument. When the piston is in place, the needle end of the syringe should be capped and syringe and contents should be boiled for an hour or more to insure sterility. Aspirating needles about seventeen or eighteen gauge have usually been used by the writer in the injections of ground rubber. These he has usually about one inch long.

When the patient is adequately prepared antiseptically for operation, the operator should attach the needle to the syringe and turn down the piston. As pressure is brought upon the syringe contents the glycerin begins to flow from the mass. This is followed by violent pops as rubber begins to pass through the needle. As long as the rubber is mixed with glycerin the flow is irregular and interrupted by more or less violent pops and spurts. No attempt should be made to inject the mixture until a steady even flow of the rubber appears. If a syringe is of adequate size this smooth flow of the mixture can always be affected. With a small syringe such might not be possible. So long as the flow is in the least intermittent no attempt should be made to inject.

When paraffin was popular with surgeons operators frequently neglected to

master the details of the technic. Such operators without experience with the flow of paraffin under various conditions attempted hasty injections with improperly prepared syringes and unfortunate results often were directly due to this lack of experience with the syringe and its contents. The maner of action of the paraffin in the tissues was not suspected by some surgeons who presumed to advise others in articles regarding the use of paraffin and had they studied the flow of this drug from their needles they would have been in a position to have given better advice. Inexperienced operators often squirted hot paraffin under the skin not suspecting that there was a better way. While rubber mixtures can be much more easily removed than paraffin it is to be hoped that surgeons using the technic will carefully study the manner of flow of the various

rubber compounds before attempting to actually inject patients for most of these injections will be called for for filling out lines and deficiencies on exposed parts of the body and a poor result from lack of care and a little experience will be deplorable to say the least.

THE TECHNIC OF INJECTING COMPOUNDS FOR FILLING DEFICIENCES

Surgeons should attempt to observe and remember certain characteristics of these injections. Emission of rubber mixtures from the needles do not as a rule tend to spread but rather tend to lump. In placing paraffin it was rather hard to place it along a narrow line. The same may be said of the rubber compounds, unless the flow is very steady and even and the needle is passed along through the tissues at an even regular rate there is a tendency of the injection to lump. This can be

guarded against if the surgeon is sufficiently careful, and as has been said before has studied the manner of flow of the rubber from the needle point. In building up saddle nose one should not try to build up on each side and then in the middle line as certain inexperienced paraffin operators were fond of suggesting years ago but every effort should be made to keep the injection as much in the middle line as is possible. If all surgeons could see some of the results of poorly done nasal bridge operations they would make every effort to master the technic before touching such cases. When the surgeon knows his instruments and the manner of flow of his mixtures pronouncedly abnormal featural contours may be altered in a most satisfactory manner.

96 The Surgeon Must Not Think That After He Gets the Injection Under the Skin He Will Be Able to Mould It As He Desires

To mould an injection after it is made is a snare which has trapped more than one unsuspecting paraffin injector. Changes which one can make by digital pressure are too uncertain to count upon. Injections must be placed right to get the effect desired be it to concentrate the injection at one point or to diffuse it through the tissues.

Another rubber which the writer tested was the partly cured rubber used in the repair of rubber articles. This material is furnished in sheets spread upon heavily sized muslin. It is easily softened with ether and in such condition may be readily injected. Reactions seemed sharper from its use than from any of the other mixtures and the writer hardly thinks that such material will prove as useful as some of the materials previously described.

Of course following all of these injections there is more or less inflammatory reaction. Some pathologists would call such state more of an acute congestion than an inflammation. There may be too during this time more or less stinging or a burning sensation about the injection. This usually subsides in a day or two and the inflammatory symptoms are usually entirely gone within a week or two. Just which injections are best tolerated it is hard to say as sometimes one is inclined to one and some times to another in this respect. The writer has used the injections in patients with a good deal of caution injecting small quantities for a variety of featural conditions. It is the cosmetic

surgeon of course who is most interested in such a treatment. While now and then a deficiency in the tissues may call for an injection the great majority of times the patient who wants such treatment will have natural lines, wrinkles, or irregularity of featural contour which it is desired to change; raising the depressed nasal bridge is one of the striking types of this class of defect. The surgeon engaged in this kind of work will see many others where changes in featural contour will produce very pronounced effects upon the appearance.

For the present patients should be told that these methods are not as yet recognized as established surgical procedures.